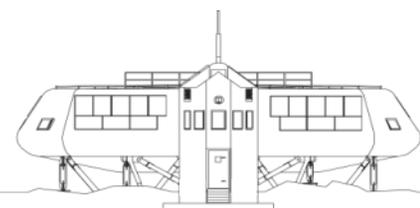


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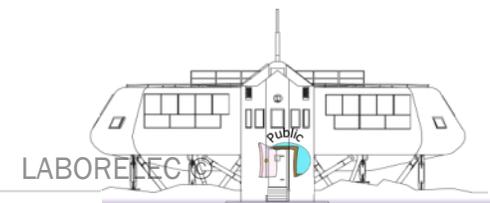
GDF SUEZ





Princess Elisabeth Antarctic Station

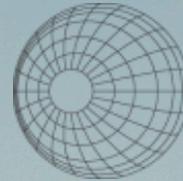
© LABORELEC - IPF



What is it?



- Belgian International Antarctic research station
- “Hotel” Accommodation (living, sleeping, working, technical, research, storage): 1500 m²
- 12 (4 crew) + 32 Visitors (summer)
- Operated in Austral summer: November – February
- Remote sensing capability (winter months)
- Remote start-up (October)
- Built-in upgrade capability (winter station, instrumentation, ...)
- +25 Years lifetime

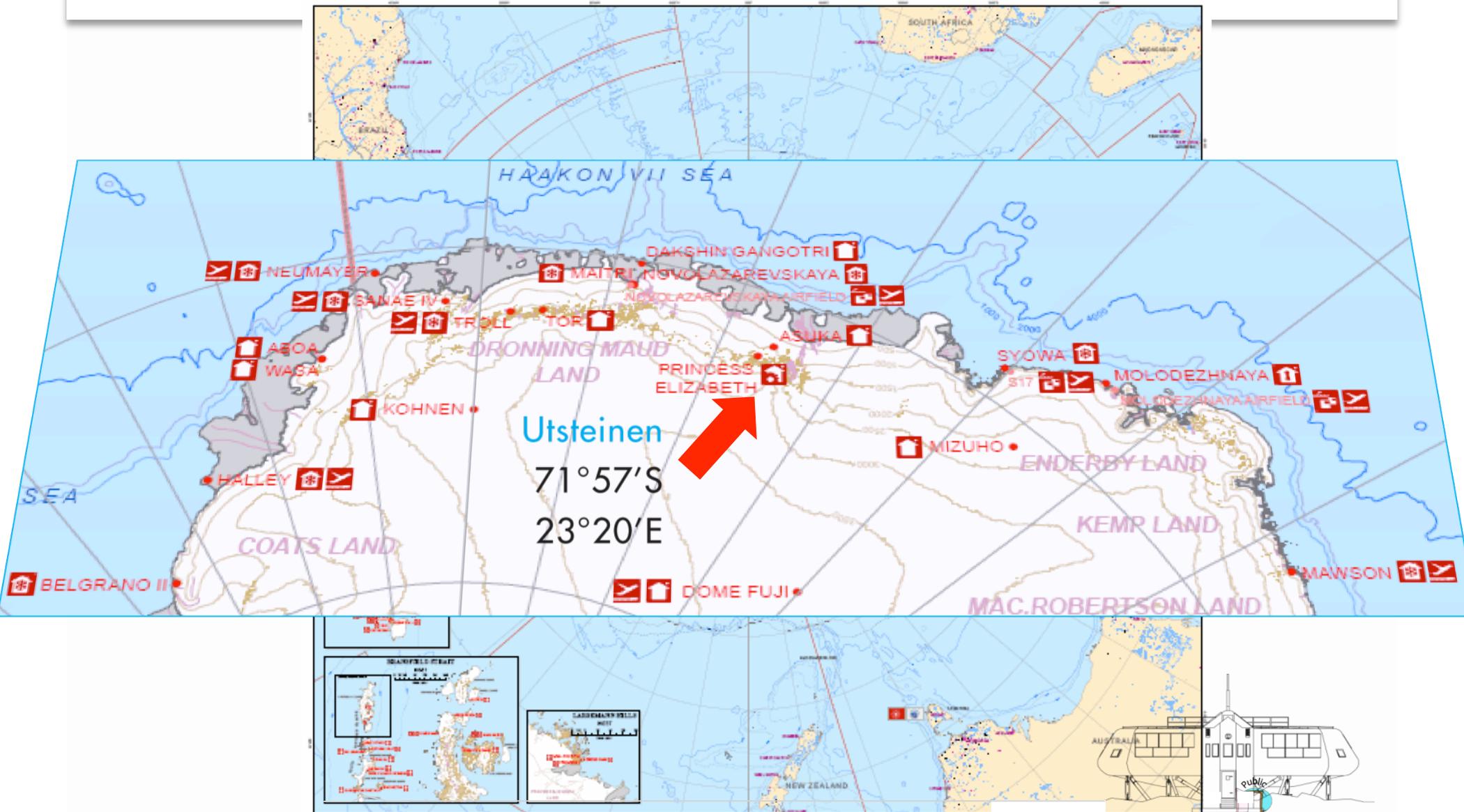


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... leading to the realisation of
the first zero-emission energy systems in
Antarctica, the Princess Elisabeth station

Location



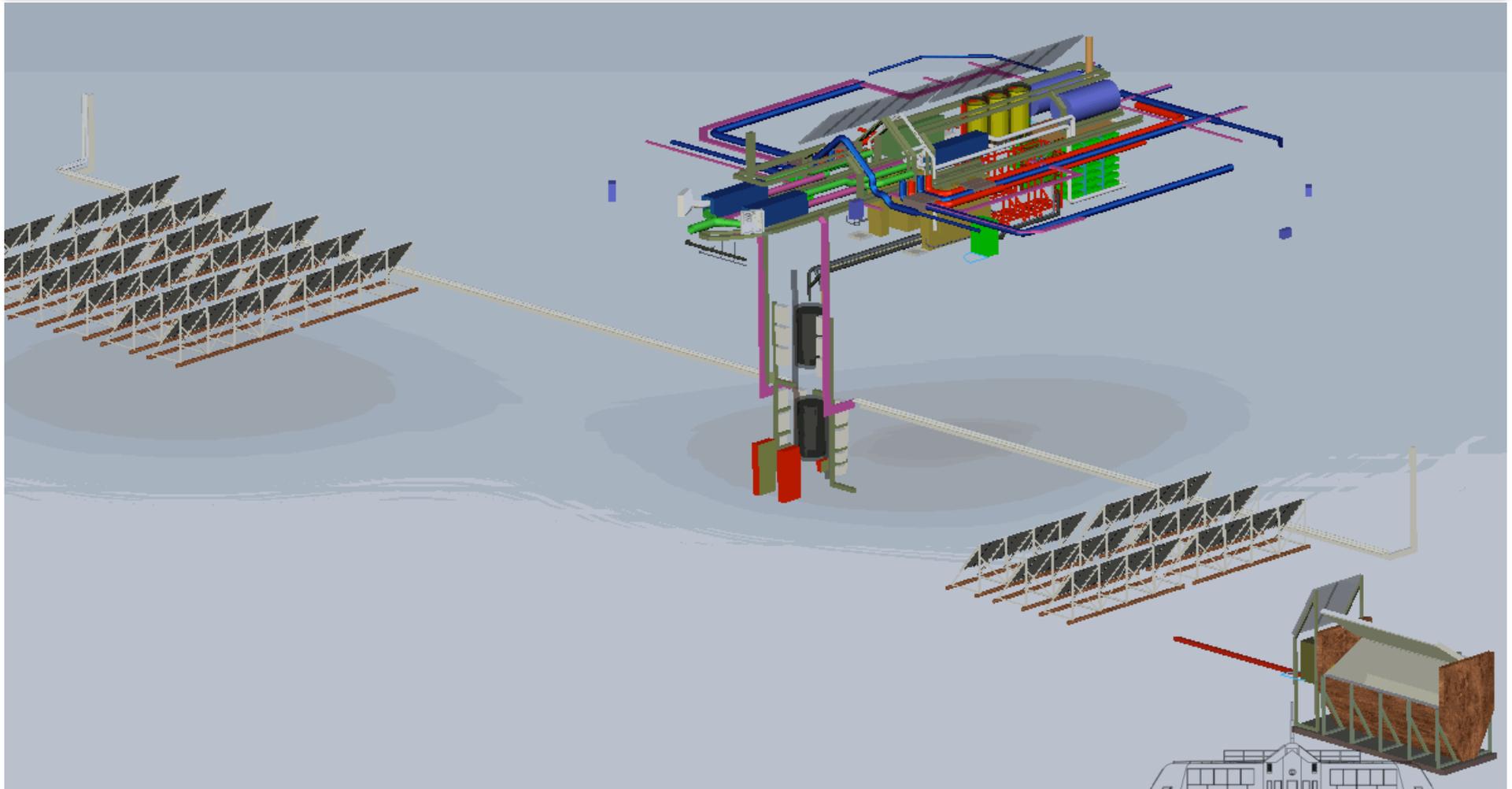


The Technical Core



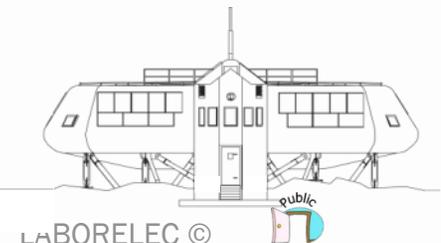
- 1: Fresh water 1500l
- 2: Recycled water 1500l
- 3: Batteries 6000Ah
- 4: Hot water 3x500l
- 5: Bioreactor modules
- 6: Ventilation core
- 7: Control system
- 8: ventilation

Energy Systems



Electrical Grid: Constraints

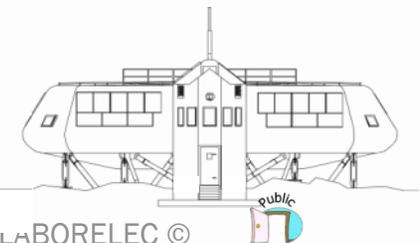
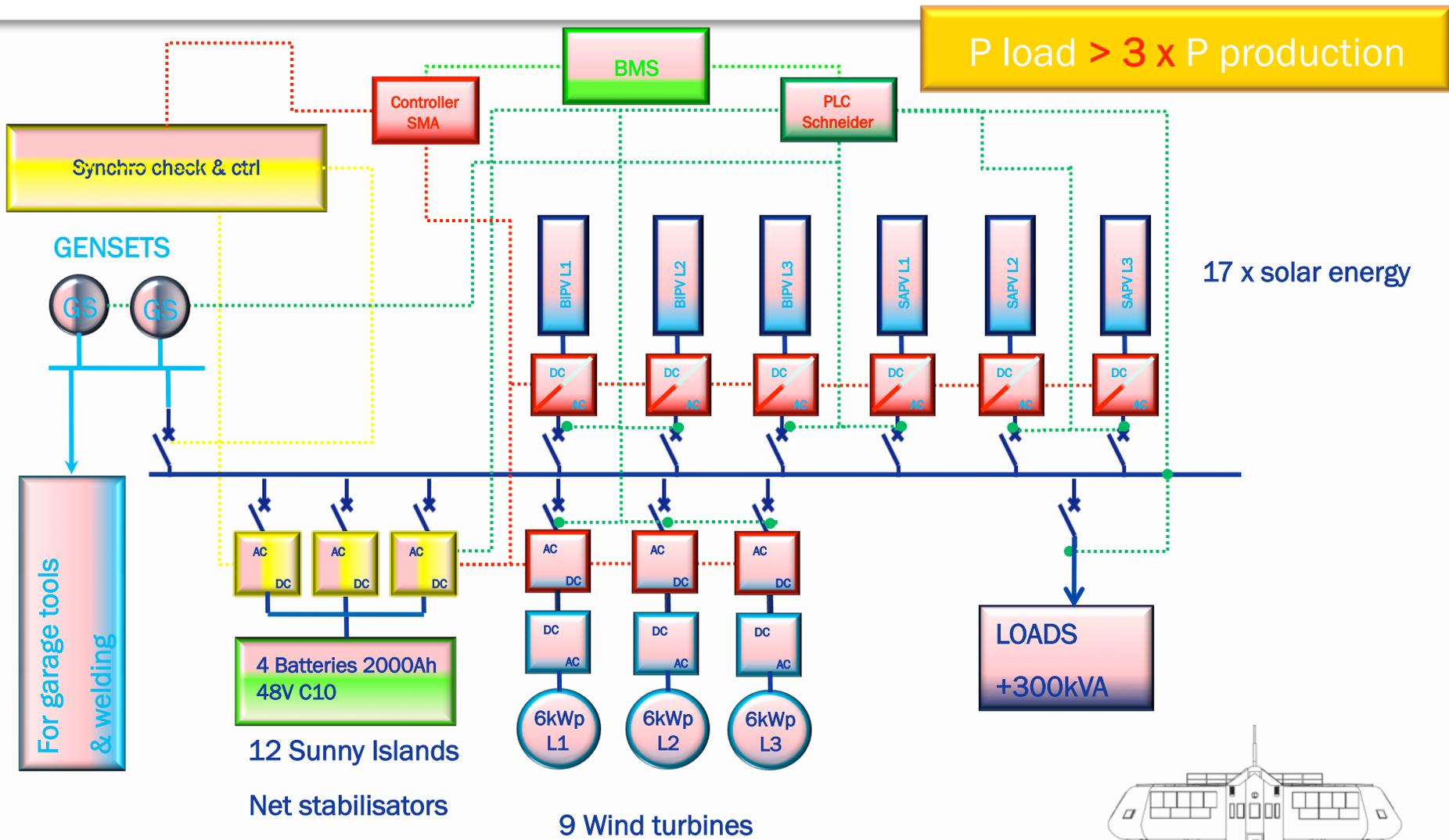
- Isolated environment: High Security!
- Low temperatures: down to -30°C
- No earthing is possible
 - Ice & granite are good isolators
- Low humidity <10% => static electricity up to kilo Volts
- Imposed Energy resources by pre-study of 3E :
 - Photovoltaic – Wind – Batteries + Gensets for backup
- Low Short circuit power 300A during 100ms (equiv. To Ucc of 25%) due to static converters => adapted protective strategy



Electrical Grid: Earthing strategy?

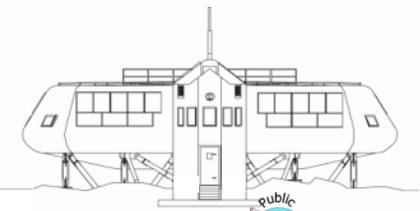


Electrical Grid: Design – Smart MicroGrid

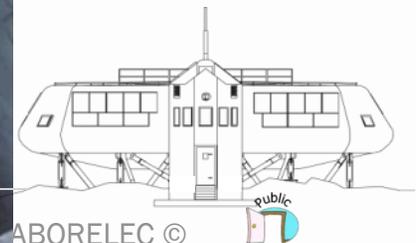


Electrical Grid: Design

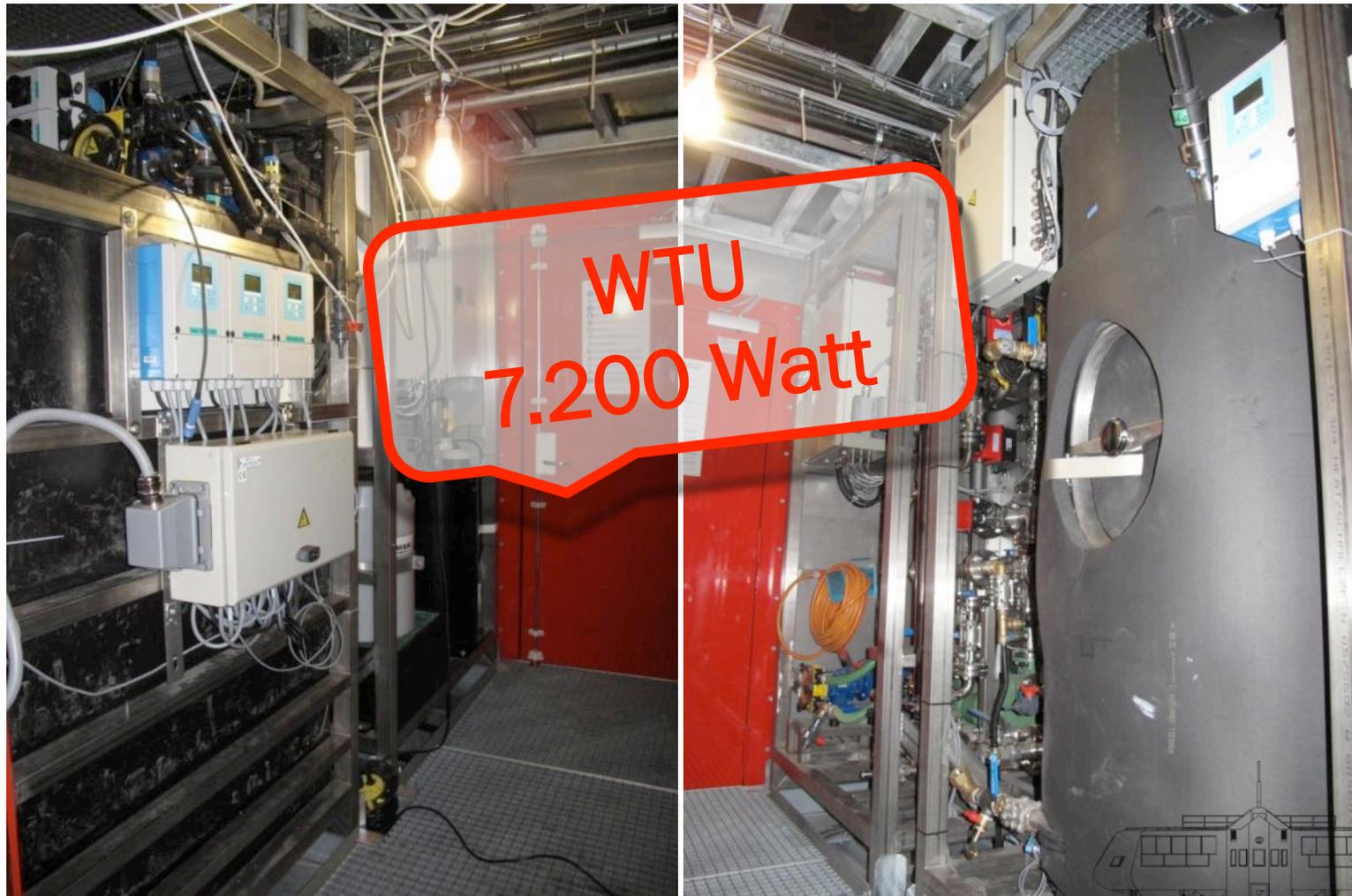
- 3 x 400V + N + “Global earthing”= interconnecting of all metallic parts (TNS-common mode)
- Controlled discharge of persons when entering the base
- Main Busbar: $I_n = 250A$
- Photovoltaic: BIPV: 17.78kWp – SAPV: 44.94kWp => aprox. 58MWh expected
- Wind: 9 x 6kWp: 54kWp => aprox. 140MWh expected
- Batteries: 48V - 8000Ah C10 @ 20°C
- Gensets: 2 x 35kW @ $\cos \varphi 0.8 \text{Ind}$ => approx. 2000l of fuel / year expected
- Variable loads: Total installed power of +400kVA
- Ensuring basic stability of the micro-grid: Sunny Island (SMA) 4 x (3 x 5kW) @ 25°C



Electrical Grid: Loads



Electrical Grid: Loads



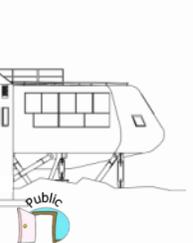
Electrical Grid: Loads



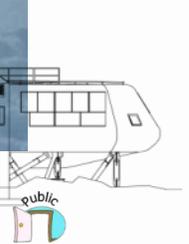
B&G - WSD
7.400 Watt



Electrical Grid: Loads



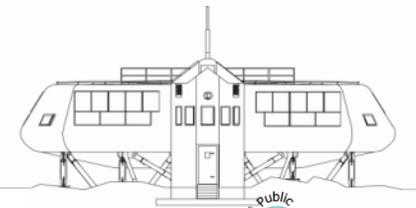
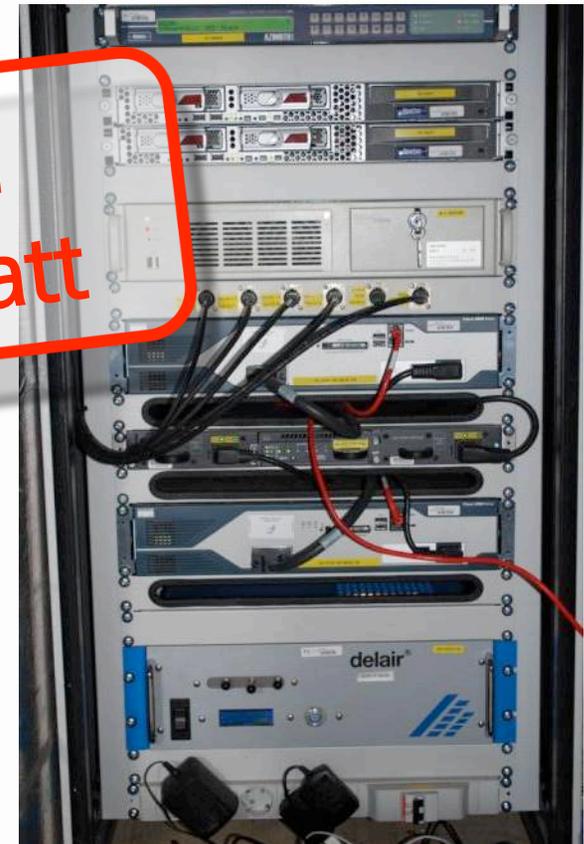
Electrical Grid: Loads



Electrical Grid: Loads ?



IT & COM
11.000 Watt





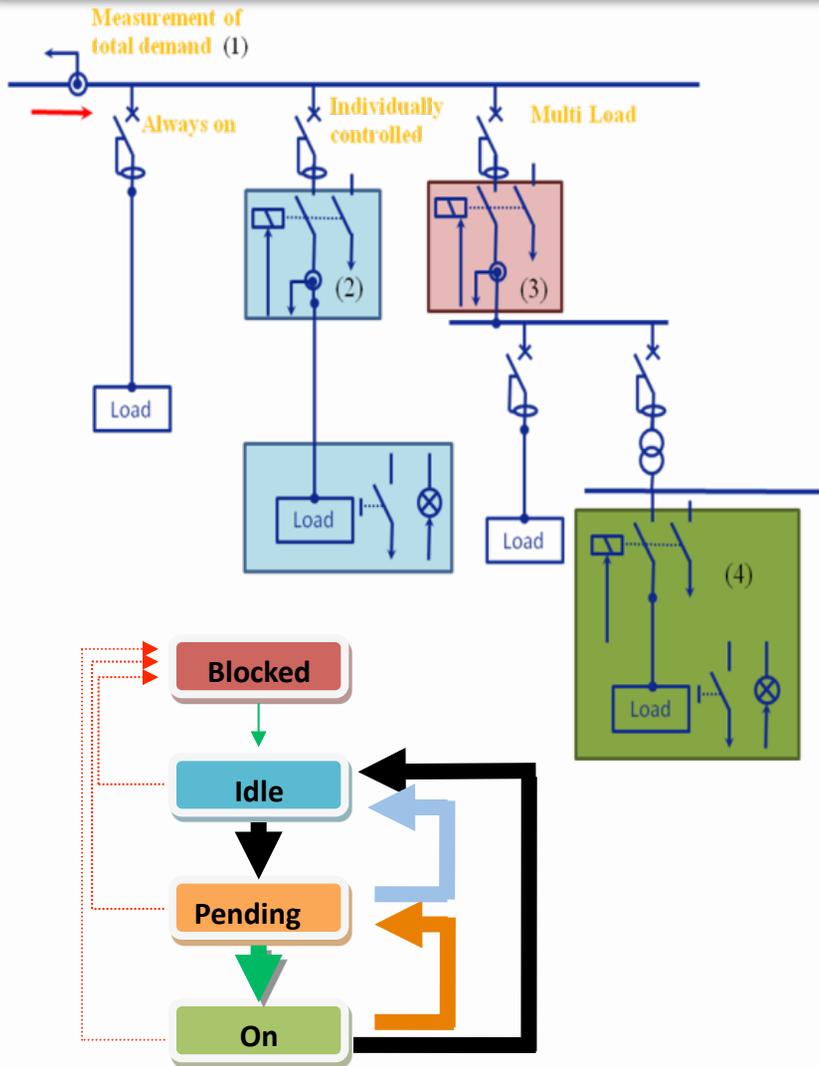
General +
Garage
+200.000 Watt
(Heating 40 kW)



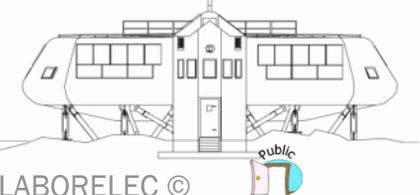
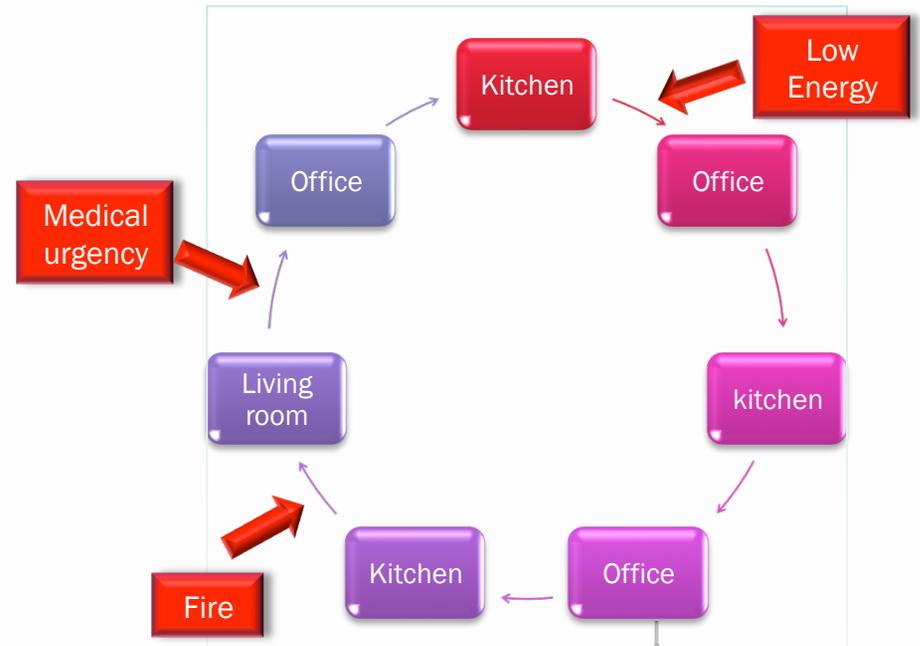
Electrical Grid: Loads ?



Smart Grid Control: DPMS © Laborelec



Event Based Management



Electrical Grid: how does it look like?

Does it works?





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Genset technology?



GEP44-5 (3-Phase)

50 HZ

STANDBY 44.0 kVA / 35.2 kW

PRIME 40.0 kVA / 32.0 kW

60 HZ

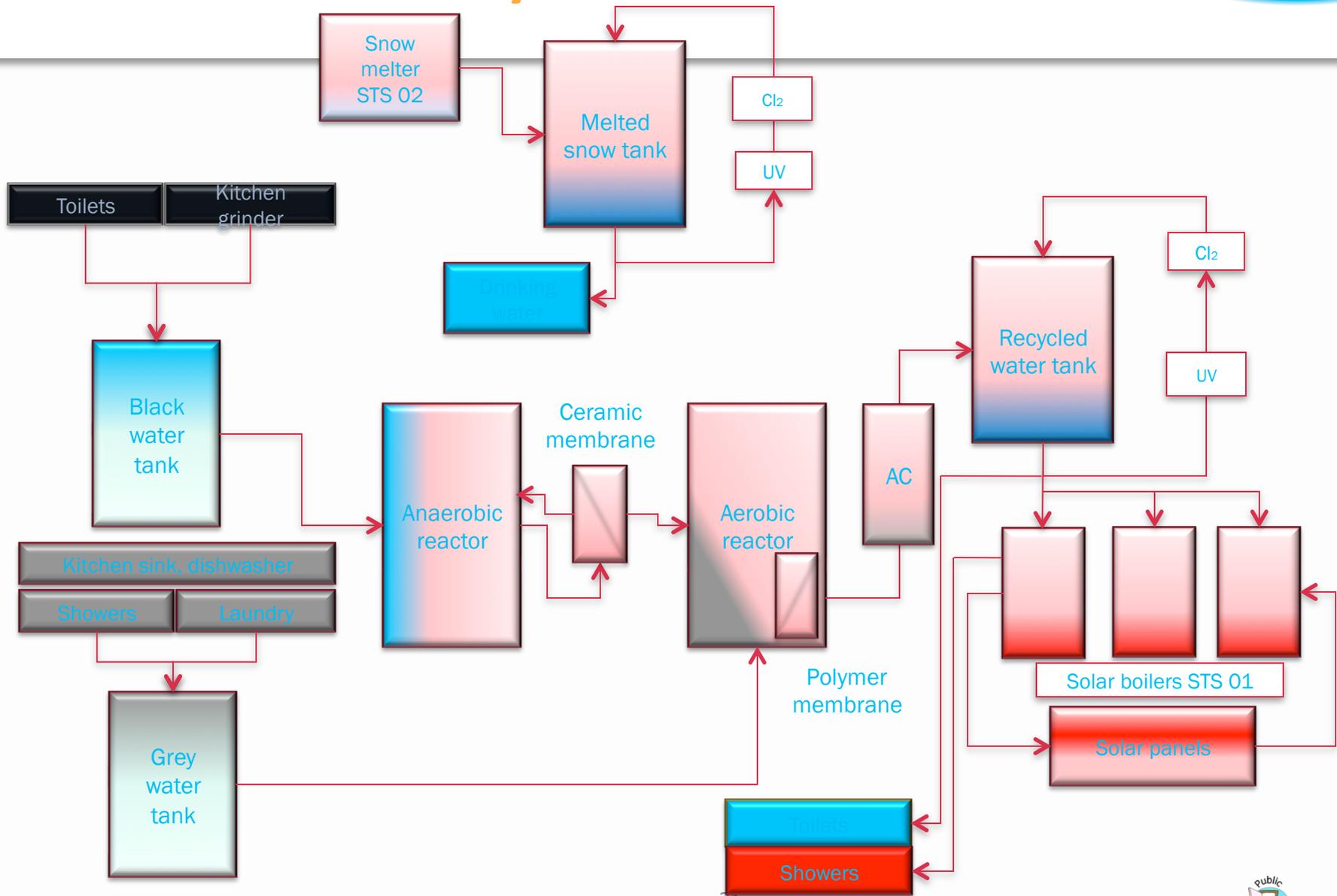
STANDBY 50.0 kVA / 40.0 kW

PRIME 45.0 kVA / 36.0 kW

Water treatment system?

- Drinking water made of melted snow
- Black water treatment
- Anaerobic treatment (anaerobic membrane bioreactor)
- Grey water treatment
- Mixed with anaerobic reactor effluent, and treated in aerobic reactor (aerobic membrane reactor)
- Final filtration on activated carbon and disinfection (bleach water and UV)
- Recycling of black water and grey water for showers and flushing water (75 % recycling)

Water treatment system?



Water treatment system?



Anaerobic reactor

Water treatment system?



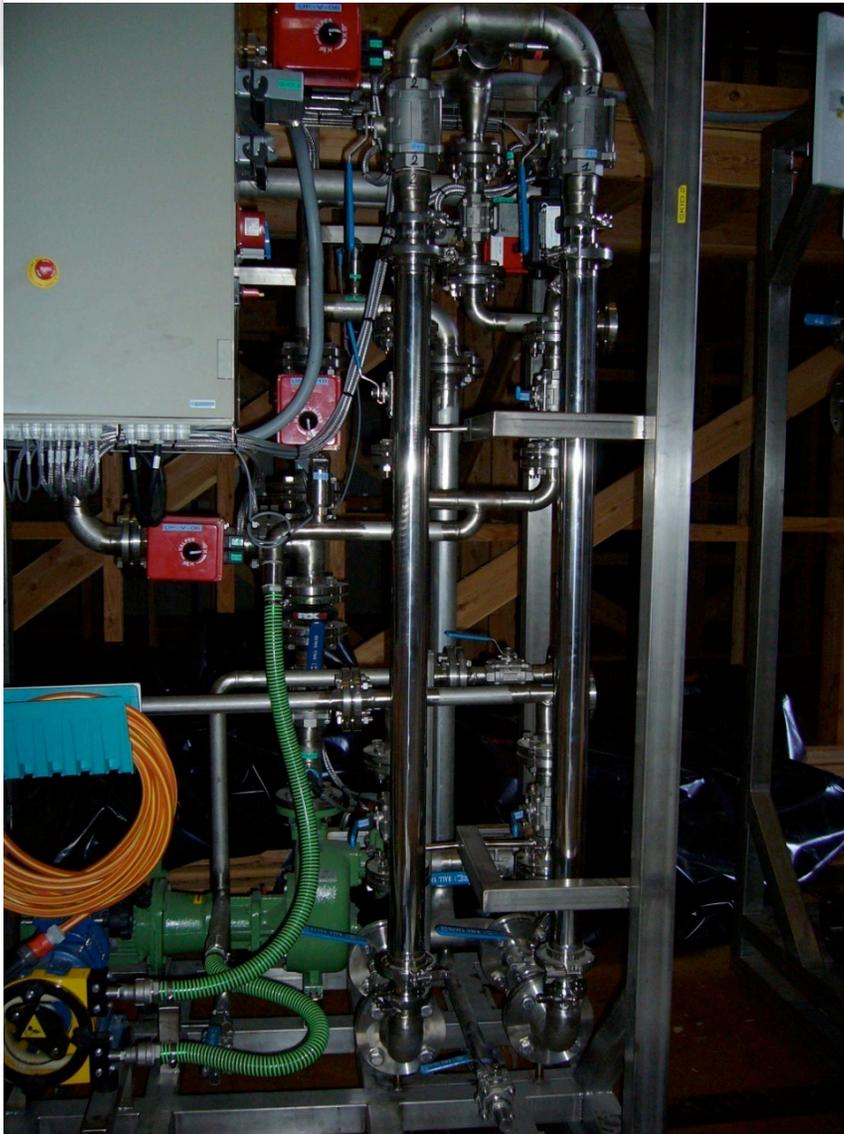
Aerobic reactor

Water treatment system?



Activated carbon
column and cleaning devices

Water treatment system?



Ultrafiltration ceramic membranes

Water treatment system?



Aerobic reactor and cleaning unit on site